REMARKS

Reconsideration and allowance of the present patent application based on the following remarks are respectfully requested.

By this Amendment, claim 1 and 23-25 are amended and claims 6, 18 and 26 are cancelled herein without prejudice or disclaimer to the subject matter recited therein. Support for the amendments to the claims can be found throughout the original disclosure. No new matter has been added. Accordingly, after entry of this Amendment, claims 1, 7-17, 19-20 and 23-25 will be pending in the application.

Response to Advisory Action

In the Advisory Action dated August 26, 2009, the Examiner contends that the proposed new limitation "wherein the catalyst is not pre-treated with hydrogen gas" would raise a new issue under 35 USC § 112, 1st paragraph because it is not supported by the specification. Applicant respectfully disagrees.

As stated in the Response dated August 12, 2009, support for the limitation "wherein the catalyst is not pre-treated with hydrogen gas" can be found throughout the initial disclosure. For example, Examples 1 to 3, all use substrate particles (silica powder) provided with nickel formate, where the nickel formate is decomposed (by heating) permitting carbon nanotube formation without any pre-treatment with hydrogen (see, pages 11-14 of the specification). On the other hand, in Example 4, it is clearly stated that hydrogen is added (5:5:1 ratio of argon to hydrogen to acetylene, total flow rate of 220 ml/min) to the gas stream of Example 3 during growth (see, page 14 of the specification). This clearly shows that in Example 3 hydrogen is NOT used because the hydrogen treatment is added in Example 4. Therefore, the specification describes and contemplates both a situation were hydrogen is used (Example 4) and a situation were hydrogen is not used (Examples 1 to 3). Claim 1 as amended only captures the situation (embodiment) were the catalyst is not pre-treated with hydrogen gas.

Consequently, Applicant submits that the pending claims are in full compliance with 35 USC § 112, 1st paragraph.

In the Advisory Action dated August 26, 2009, the Examiner agrees that Resasco, Tennent I (Tennent '909) and Tennent II (Tennent '543) teach that the catalyst is pre-treated with hydrogen. Therefore, in view of this acknowledgement,

Applicant respectfully requests that the rejection of the claims over Resasco, Tennent I and Tennent II be withdrawn.

Claim Rejections – 35 USC § 102

Claim 26 was rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent No. 6,333,016 to Resasco et al. (hereinafter "Resasco '016").

Claim 26 has been cancelled herein without prejudice or disclaimer to the subject matter recited therein. Therefore, the rejection of claim 26 is rendered moot.

Claim Rejections – 35 USC § 103

Claim 1, 6-13, 15-19 and 24-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016 in view of U.S. Patent No. 5,165,909 to Tennent et al. (hereinafter "Tennent '909") and U.S. Patent No. 5,578,543 to Tennent et al. (hereinafter "Tennent '543") and further in view of U.S. Patent Application Publication No. 2003/0086859 to Kawakami et al. (hereinafter "Kawakami"). Applicant respectfully traverse this rejection for at least the following reasons.

Claims 6, 18 and 26 have been cancelled herein without prejudice or disclaimer. The subject matter recited in claims 6 and 18 is now captured in claim 1.

Applicant has further amended claim 1 to recite, *inter alia*, "the catalyst is not pre-treated with hydrogen gas."

Support for this amendment can be found throughout the initial disclosure. For example, the Examiner is directed to Examples 1 to 3, which all use substrate particles (silica powder) provided with nickel formate, where the nickel formate is decomposed (by heating) permitting carbon nanotube formation without any pre-treatment with hydrogen.

An embodiment of the present invention relates to a continuous method for the production of carbon nanotubes. The method uses a transition metal catalyst formed by decomposing nickel, iron or cobalt formate or oxalate to yield the transition metal under a non-reducing atmosphere. The transition metal catalyst is not treated with hydrogen gas prior to catalysing the formation of carbon nanotubes.

Applicant respectfully submits that there is nothing in the cited portions of Resasco '016, Tennent '909, Tennent '543 and Kawakami, alone or in combination, that remotely discloses, teaches or suggests these aspects of claim 1.

Resasco '016 discloses a method of producing carbon nanotubes involving the step of forming a bimetallic catalyst *in situ* through decomposition of a precursor compound such as bis(cyclopentadienyl) cobalt or bis(cyclopentadienyl) molybdenum chloride (see, column 5, lines 26 to 29 in Resasco '016). As the Examiner acknowledges, Resasco '016 does not disclose, teach or suggest that the metal salt can be a formate or oxalate. In addition, Resasco '016 does not disclose, teach or suggest a nickel, iron or cobalt formate or oxalate.

Furthermore, the methods disclosed in Resasco involve pre-treatment of the metallic catalysts with hydrogen gas before reacting the catalyst with a carbon source (see, for instance Examples 1 to 6 in cols. 8-11 in Resasco '016). It is therefore submitted that Resasco '016 does not disclose, teach or even suggest the subject matter recited in claim 1.

The Examiner contends that Tennent '909 teaches a method of forming carbon nanotubes comprising the steps of forming a catalyst from a decomposable metal salt such as an oxalate, decomposing the metal salt in a non-reducing atmosphere to form the catalyst and flowing a carbon gas, such as methane or acetylene comprising argon as a diluent over the catalyst to form carbon nanotubes. The Examiner contends that it would have been obvious to one of ordinary skill in the art to have used the oxalate salt as taught in Tennent "909 in the method of Resasco. Applicant respectfully disagrees.

Tennent '909 fails to overcome the deficiencies noted above in Resasco '016. Tennent '909 discloses a method of forming a carbon fibril. The catalyst used can be a metal containing particle derived from metal salts that thermally decompose to metallic particles or metallic oxide particles. Suitable metal salts include carbonates, bicarbonates, nitrates, citrates and oxalates (column 8, lines 5 to 10). While Tennent '909 discloses that various metal salts, including oxalates, can be thermally decomposed to the metallic particles or metallic oxides, the examples in Tennent '909 demonstrate that carbon fibrils were only generated under conditions where the catalyst was treated with hydrogen prior to contact with the carbon-containing gas (see, col. 13, lines 39 to 42 and Table 1). Therefore, Tennent '909 teaches away from not using hydrogen when pre-treating the catalyst by in fact treating the catalyst with hydrogen.

Taking the overall teaching of Tennent into account, one of ordinary skill in the art would understand that carbon nanotubes would only be formed where the metallic catalysts of Tennent '909 are pre-treated with hydrogen gas. Therefore, one of ordinary skill in the art would not consider that a metal catalyst formed from a metal oxalate could be used to generate carbon nanotubes, unless the catalyst is pre-treated with hydrogen.

Therefore, there is no objective reason why one of ordinary skill in the art would combine Tennent '909 with Resasco '016 to produce carbon nanotubes using a catalyst that is not pre-treated with hydrogen gas.

In addition, even if one were to combine Resasco '016 and Tennent '909, there is nothing in Tennent '909 that would result in the skilled person arriving at the method of the present invention.

The Examiner concedes that Resasco '016 and Tennent '909 fail to teach that the particles are fluidized and that transition metal is heated on the substrate. The Examiner, however, contends that Tennent '543 teaches a method of forming nanotubes by reacting a carbon source gas with catalyst coated particles wherein the particles are fluidized during continuous reaction. The Examiner further contends that Kawakami discloses that elution is a technique known in the art for collecting nanoparticles. The Examiner contends that it would have been obvious to one of ordinary skill in the art to have fluidized particles and to collect the nanoparticles by elution. Applicant respectfully disagrees.

Neither Tennent '543 nor Kawakami overcome the deficiencies noted above in the combination of Resasco '016 and Tennet '909. Tennent '543 discloses a continuous method for producing carbon fibrils by contacting at a suitable pressure metal containing particles with a suitable gaseous carbon-containing compound (see, col. 3, lines 47 to 50 in Tennent '543). These metal containing particles do not need to be in an active form before entering the reactor where the carbon fibrils are made as long as they can be readily activated through a suitable pre-treatment or under reaction conditions. Similarly to Tennent '909, the examples of Tennent '543 demonstrate that carbon fibrils were only formed where the pre-treatment conditions included pre-treatment with the reducing gas hydrogen (see, Table 1 in Tennent '543). Therefore, Tennent '543 does not disclose a method of producing carbon nanotubes where the catalyst is not pre-treated with hydrogen gas. Hence, similarly

to Tennent '909, Tennent '543 teaches away from not pre-treating the catalyst with hydrogen. Consequently, even if one were to combine Tennent '543, Tennent '909 and Resasco '016, one of ordinary skill in the art would not achieve the method of production of carbon nanotubes as recited in claim 1.

Kawakami discloses a method for producing carbon nanotubes in a supercritical or subcritical fluid. The method in Kawakami involves contacting an aromatic compound containing starting material with a transition metal element-containing catalyst in a supercritical or subcritical fluid at a temperature of from 350°C to 800°C and pressure of from 3 MPa to 50 MPa (see, paragraph 0023 in Kawakami). One of ordinary skill in the art would understand that reaction processes are often very different when performed under supercritical and subcritical fluid conditions when compared to reactions occurring at much closer to ambient conditions, for instance at the pressures of the reaction of the presently claimed invention, where the reaction occurs with a gaseous carbon source, i.e. not in a supercritical or subcritical fluid. Therefore, there is no objective reason that one of ordinary skill in the art would consider that the catalysts of Kawakami could be used to produce nanotubes at pressures much closer to ambient conditions.

In addition, even if one of ordinary skill in the art were to combine the teaching of Kawakami with Resasco '016, Tennent '909 and Tennent '543, this would involve using the catalysts of Kawakami in the methods of Resasco '016, Tennent '909 and Tennent '543. In other words, the catalyst would be subject to pre-treatment with hydrogen gas. Thus, the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami would simply not teach, disclose, or suggest the method od production of nanotubes as claimed in claim 1.

Consequently, none of Resasco '016, Tennent '909, Tennent '543 and Kawakami, taken alone or in combination disclose, teach or suggest the subject matter recited in claim 1.

Therefore, Applicant respectfully submits that claim 1 is patentable over the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami.

Claims 7-13, 15-17, 19 and 24-25 depend from claim 1. Therefore, claims 7-13, 15-17, 19 and 24-25 are patentable by virtue of their dependency on patentable claim 1 and for the additional limitations recited therein. Thus, it is respectfully requested that the rejection of claims 1, 7-13, 15-17, 19 and 24-25 under 35 U.S.C. §

103(a) over the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami be withdrawn.

Claim 14 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016, Tennent '909, Tennent '543 and Kawakami and further in view of U.S. Patent No. 5,997,832 to Lieber et al. (hereinafter "Lieber"). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 14 depends from claim 1. Therefore, for at least the reasons provided above with respect the claim 1, Applicant respectfully submits that claim 14 is patentable over the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami.

Lieber fails to overcome the deficiencies noted above in the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami. Lieber was relied upon as allegedly disclosing a method of forming "carbon nanotubes" wherein a carrier particle such as fumed alumina is coated with a metal catalyst and a hydrocarbon gas is reacted with the catalyst to form carbon nanorods. Lieber does not disclose, teach or suggest the subject matter recited in claim 1. Furthermore, Lieber discloses methods of making carbide nanorods. According to Lieber, "carbide" means a compound of carbon and one or more elements more electropositive than carbon, excluding hydrogen (see, col. 3, lines 50-52 in Lieber). A carbide is chemically different from a carbon nanotube and a person skilled in the art would realize that different synthetic methods are required. Accordingly, a skilled person would not consider Lieber when intending to make carbon nanotubes and would not combine Lieber with Resasco '016, Tennent '909, Tennent '543 and Kawakami.

Consequently none of Resasco '016, Tennent '909, Tennent '543, Kawakami and Lieber, alone or in combination, disclose, teach or suggest the subject matter recited in claim 14.

Therefore, Applicant respectfully submits that claim 14 is patentable over the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami and Lieber. Thus, it is respectfully requested that the rejection of claim 14 under 35 U.S.C. § 103(a) over the combination Resasco '016, Tennent '909, Tennent '543, Kawakami and Lieber be withdrawn.

Claim 20 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016, Tennent '909, Tennent '543 and Kawakami and further in view of U.S. Patent No. 6,955,800 to Resasco et al. (hereinafter "Resasco '800"). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 14 depends from claim 1. Therefore, for at least the reasons provided above with respect the claim 1, Applicant respectfully submits that claim 20 is patentable over the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami.

Resasco '800 fails to overcome the deficiencies noted above in the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami. Resasco '800 teaches a method for catalytic production of carbon nanotubes. Resasco '800 does not disclose, teach or suggest the subject matter recited in claim 1. In addition, Resasco '800 does not disclose the catalyst precursors recited in claim 1, instead Resasco '800 provides a similar disclosure in this regard as Resasco '016 (see, column 7, lines 32 to 35 in Resasco '800). In common with Resasco '016 and Tennent '909 and Tennent '543, the method of Resasco '800 involves exposing the catalytic particles to a reducing gas such as hydrogen (see, column 3, line 65 to column 4, line 12 in Resasco '800). Thus, even if one were to combine Resasco '800 with the other citations (Resasco '016, Tennent '909, Tennent '543 and Kawakami), one of ordinary skill in the art would not achieve the method of production of carbon nanotubes claimed in claim 1.

Consequently none of Resasco '016, Tennent '909, Tennent '543, Kawakami and Resasco '800, alone or in combination, disclose, teach or suggest the subject matter recited in claim 20 which depends from claim 1.

Therefore, Applicant respectfully submits that claim 20 is patentable over the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami and Resasco '800. Thus, it is respectfully requested that the rejection of claim 20 under 35 U.S.C. § 103(a) over the combination of Resasco '016, Tennent '909, Tennent '543, Kawakami and Tennent '800 be withdrawn.

Claim 23 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016, Tennent '909, Tennent '543 and Kawakami and further in view of U.S.

Patent No. 6,290,775 to Kohlen et al. (hereinafter "Kohlen"). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 23 depends from claim 1. Therefore, for at least the reasons provided above with respect the claim 1, Applicant respectfully submits that claim 23 is patentable over the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami.

Kohlen fails to overcome the deficiencies noted above in the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami. Kohlen was relied upon as allegedly disclosing fluidized bed reactors that can be arranged vertically or at an angle. Kohlen does not disclose, teach or suggest the subject matter recited in claim 1. Consequently none of Resasco '016, Tennent '909, Tennent '543, Kawakami and Kohlen, alone or in combination, disclose, teach or suggest the subject matter recited in claim 23 which depends from claim 1.

Therefore, Applicant respectfully submits that claim 23 is patentable over the combination of Resasco '016, Tennent '909, Tennent '543 and Kawakami and Kohlen. Thus, it is respectfully requested that the rejection of claim 23 under 35 U.S.C. § 103(a) over the combination Resasco '016, Tennent '909, Tennent '543, Kawakami and Kohlen be withdrawn.

CONCLUSION

Having addressed each of the foregoing rejections, it is respectfully submitted that a full and complete response has been made to the outstanding Office Action and, as such, the application is in condition for allowance. Notice to that effect is respectfully requested.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

Date: **October 13, 2009**

Respectfully submitted,

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